GIS Mapping of Micro-Urban Heat Islands Using GPS and Landsat Thermal Data

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Goal and Scope. Urban build-up often includes area wide tree removal to construct new highly reflective parking lots, roof tops, roads and warehouses. This can lead to an increase in thermal radiation at the surface to produce micro-urban heat islands (MUHI) in localized areas. Major factors leading to the formation of heat islands are the effects of street canyon geometry, thermal properties of materials and waste heat from other buildings. This study presents a record of changing MUHI's over a ten year period in a portion of the Dallas/Fort Worth metroplex using satellite data and a geographical information system (GIS).

Methods. Most heat island studies use a combination of meteorological stations readings, auto traverse techniques and computer modeling to document weather conditions, temperatures, surface conditions and heat dissipation. Our study uses the visible, infrared and thermal digital data from Landsat TM to record and map MUHI patterns over the Dallas/Fort Worth study area. Satellite studies offer easy repeatability and synoptic coverage. The thermal band on Landsat TM is particularly useful in determining surface temperature variations useful in identifying specific locations of heat islands. As urban temperatures increase in a city, more energy is needed for cooling in the summers. Landsat TM satellite thermal digital data, maps and GPS stations are used to map the extent and location of micro-urban heat islands over the last ten years. These data are incorporated into a GIS to monitor and display the changing land use patterns and document the growth of heat islands in the urban study area.

Results and Conclusions. This study demonstrates the usefulness of Landsat TM for mapping micro-urban heat islands (MUHI) in a portion of the Dallas/Fort Worth metroplex. Over a ten year period, there has been a measurable increase in the formation and distribution of MUHI's in our study area. The heat islands were 5-11 degrees warmer than surrounding areas as recorded by the satellite sensors during repetitive mid-morning passovers.

Recommendations and Outlook. In a time of growing energy supply concerns, we have to begin to look at all of the possibilities to reduce consumption. Locating and tracking MUHI's will help isolate areas of higher than normal energy use in urban areas. The impact of these heat islands can then be assessed and reduced with tree planting and/or surface cover alterations.